The Tool For Sport Pattern:

Hammer 40

By Dick Sarpolus

Borrowing the aesthetics of its smaller brother, this sport/pattern design for .40's offers you a choice of one-piece wing design or plug-in panels for ease of transportation and storage.

PHOTOGRAPHY: DICK SARPOLUS

A desire to try an aircraft with plug-in wing panels for a true mid-wing configuration led to the design and construction of the project presented here, the *Hammer 40*. I saw plug-in wings as a useful feature for three reasons: first, it enables a mid-wing location in the fuselage without the necessity for a weakening cutout deep into the fuselage; second, it provides additional room for the radio equipment installation as the wing no longer takes up space in the fuselage; and third, two smaller wing panels are easier to store and transport than one large one-piece wing. I wanted to find out just how much work was involved with plug-in wings, what to do about the aileron linkage, what the weight penalty, if any, would be, and anything else that could be learned. Experience is the best teacher, so I headed for the drafting table.

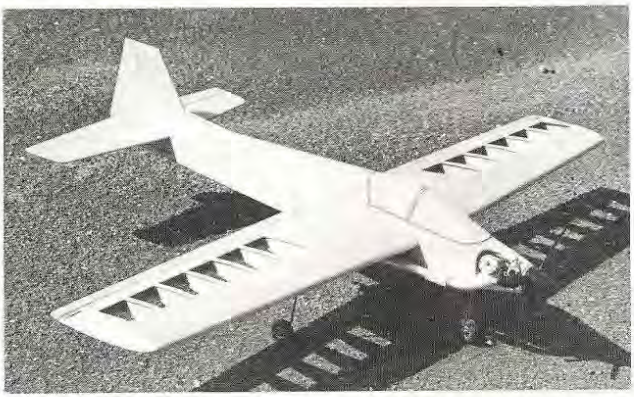
A .40 sized design was laid out as I find this medium size engine/aircraft combination quick to build, easy to transport, and just about as capable as the larger .60 models. In this size, the plug-in wing advantage of easier transporting doesn't apply as the one piece wing would only be 60 inch span anyway. The plug-in wing would really be a benefit in quarter scale models and there is one on my drafting table now. The *Hammer 40* is generously sized for a .40; 60 inch span, 49 inch length, with 630 square inches wing area. Not too many years ago, this would have been considered a .60 sized aircraft; but today's powerful .40s, or even a .45, move it very well.

Rather than work out new styling, I borrowed the general appearance of the *Hammer* design, a .20 – .25 aircraft presented in the July, 1983 FLYING MODELS. The design itself couldn't be directly scaled up but I had been pleased with the overall appearance so used the styling here again. I felt that because of the plug-in feature's additional complexity it would not be desired by many modelers so also laid out a version with a more conventional low wing location; the wing is slightly recessed into the fuselage.

The plans for this project show several variations and options. The wing can be either foam cored or built-up; for a scratch builder the foam version would probably be faster and easier. I can recommend Marc Salvador, C/O Par Troy Sound, Sussex County Mall, Rt. 206, Newton, New Jersey 07860 as a source for the foam cores. Another choice must be made between the one piece wing and the plug-in version; if the plug-in wings are used, it provides extra room for the radio gear which would permit a tuned pipe from a rear exhaust engine to be enclosed within the fuselage. A side exhaust engine could have the tuned pipe mounted beneath the plug-in wing by tilting the engine over, or with an upright engine on the low wing version, the pipe can be mounted beside the fuselage. Although the plans don't show it, a version of the *Hammer 40* has been built as a taildragger; it worked out well. Take your choice.

At this time, at least four *Hammer 40's* have been completed and are flying. They fly well and their owners are pleased. I have flown both the low and mid-wing versions and can't say that either is better. Unless you prefer the mid-wing appearance enough to do the extra work, I suggest the conventional low wing version for its easy, quick building. My mid-wing *Hammer* weighed 5½ pounds ready to fly; the low wing construction should be a bit lighter.

For a plug-in wing spar, I used a piece of ¾ inch diameter 6061-T6 aluminum tubing, as suggested by FM's editor Bob Hunt. This tubing is available from Frank Costello, 27 Kearney St., Dover, New Jersey 07801. I couldn't find a source for ¾ inch, inside diameter fiberglass or phenolic tubing, so made my own by spraying the aluminum tube with mold release and spiral wrapping it with one layer of heavy fiberglass cloth and epoxy glue. The resulting fiberglass tube was cut into three sections, one for each wing



It shares the same name and overall style as its smaller predecessor, the .25 size *Hammer*, but the *Hammer 40* is a different airplane. It uses mid-wing, plug-in wings with a pretty generous span (60") and area (630 in.^{2}).

panel and one for the fuselage. To keep the wings in position, I used a 1/8 inch wire pin near the trailing edge of the root rib which plugged into a brass tube in the fuselage side. The wings were held to the fuselage with two right angle nylon brackets made from large control horns.

An easy aileron set-up would be to mount a small servo in each wing panel and plug the servo leads into the receiver when the wings were installed. On my prototype, I made a plug-in aileron linkage using square brass tubing. Square tubing was soldered to the wire torque rods mounted in the strip ailerons. The aileron servo, mounted in the fuselage, was connected to two shortened aileron fittings with their own brass tube bearings mounted in plywood supports. Larger square brass tubes accepted the plug-in aileron pieces as the wings were installed. All the fittings were assembled with silver solder for more strength. Once set up, the linkage worked fine. High speed dives and rolls revealed no flutter problems.

K&B .40 R/C

I have used K&B engines for years and for this new aircraft I decided to try the latest version of the "good old" K&B .40 R/C. This engine has had many changes over the years and the new version sure has some nice features. The bolt-on muffler is convenient and this feature makes it easy to attach a tuned pipe adapter if desired. I was happy to see the new 1/4 inch prop shaft, eliminating the need for a special step reamer to modify the propellers as was previously necessary. K&B's new carburetor also works well and I found the idle needle convenient to adjust. Internally, there is a new connecting rod, better bearings, revised piston and crankshaft, all of which should make the engine even more reliable.

I wanted to use a tuned pipe, and obtained one of Mac's Products new Pre-Tuned Systems. The header simply bolted to the K&B .40 and was already cut to the proper length for use with their muffled tuned pipe. Also furnished as part of the package was the silicone tube connector, tie straps, and a pipe mounting bracket that worked well. Something else tried was a three-bladed prop – not for any possible noise reduction but to see how well they worked. Appearance *is* a factor; I like the way the prop looks. Zingali offers several sizes of three bladed props and the three notched spinners to go with them. I first tried the 10-6 three blade and found it was too much for the .40; the 9-6 three blade worked very well and I intended to switch to a 10-6 two blade Zinger to see if there was any difference.

I never had the chance to switch props; an elevator servo failure, I believe, resulted in a straight-in dive which very badly damaged my *Hammer 40.* This occurred during the sixth flight; I had enough air time with the model to be happy with it, and have flown several other *Hammer 40*'s built by local modelers. I couldn't face repairing the aircraft but a fellow club member, Jeff Chernet, gathered up the pieces and several weeks later, to my surprise, showed up with a fully repaired, good looking airplane. Jeff has promised to let me fly it once in a while, so I don't feel too bad about my loss.

Dick's mid-wing version used the latest version of the K&B .40 with a 3-bladed Zingali prop and a Mac's Products muffled tuned pipe.

Construction

Except for the plug-in wing feature, the construction will go quickly for any fairly experienced builder. It will be an evening or two of work to cut out all the parts before starting construction; not so bad. I have a band saw which helps a bit, particularly when making more than one "kit", or set of parts. I wanted to see several variations of this design before finalizing the plans, so cut out several sets of parts and gave them to some friends willing to try a new design. No two modelers will end up with identical planes even when starting with the same pieces; each has their own ideas and preferences when building, shaping, and sanding which can make a difference in the project's final appearance. As a designer, it's interesting to see how the final result will vary from what was expected or planned. Fortunately, all the aircraft flew well.

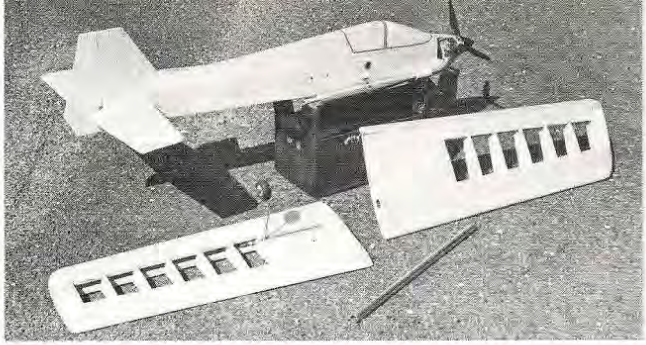
Wing. The foam version would be the fastest way to go, and if you do go with foam, I would recommend attaching the 1/16 inch balsa wing skins with well-spread-out epoxy glue; it's a strong and light method. If you choose the built-up version, cover the plans with waxed paper and pin the lower spar in place. The ribs are added; I suggest cutting the ribs with "feet" at the trailing edge so they can be pinned to the building board, rather than shimming each rib to position it correctly. Then add the upper spar, upper trailing edge sheeting, leading edge, and the leading edge sheeting. When dry, remove the wing panel from the building board, turn it over and add the bottom sheeting. The landing gear blocks and their plywood doublers must be glued in place. Add the trailing edge, capstrips, center section planking, and the wing tip blocks. The wing planform is equal taper, so the left panel can be built over the same plan by reversing the ribs.

The two panels are joined with the tips blocked up for the proper dihedral. Fiberglass cloth and epoxy are used to reinforce the wing center section joint. Conventional strip aileron linkage is added to the trailing edge.

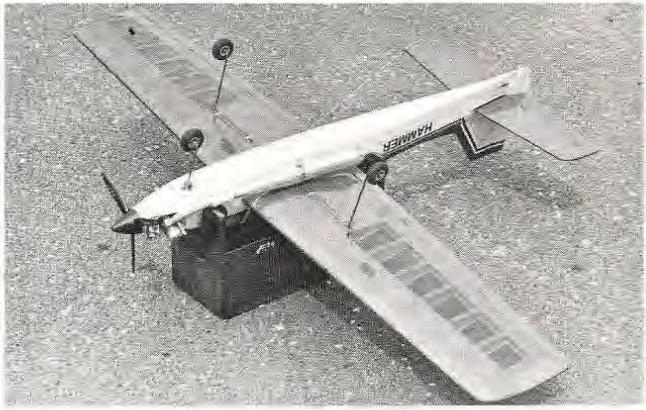
For the plug-in wing version, I used fiberglass tubes made up as described earlier and cut holes in the five innermost ribs, between the top and bottom spars, to accept the tubes. On the root and fifth rib, 1/16 inch plywood doublers around the holes were used for reinforcement. The tubes were angled to provide as much dihedral as possible, given the distance available between the spars. With the fiberglass tubes loosely fitted in the wing panels, the aluminum spar was inserted into both wings, the wing panels lined up, and the fiberglass tubes epoxied in place to the ribs.

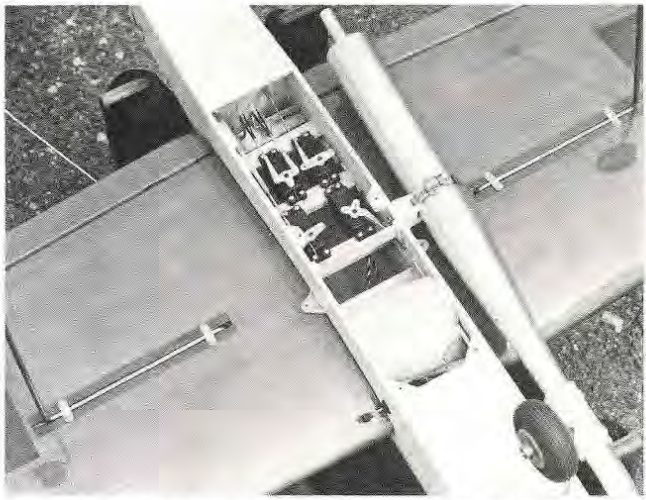
For a foam core, a plywood root rib and a partial plywood rib inserted into the core about ten inches from the root, both with holes to accept the fiberglass tube, are used to mount and locate the tube. The plywood ribs should have the holes located so as to provide the desired dihedral. The end of a metal tube could be heated and used to melt a hole through the foam, or a section of the foam could be cut out for the tube and foam pieces fitted back into the core above and below the tube. The fiberglass tube should be made as light as possible; I used heavy cloth and overlapped it too much, making the resulting tube rather heavy.

Fuselage. Construction is begun by gluing



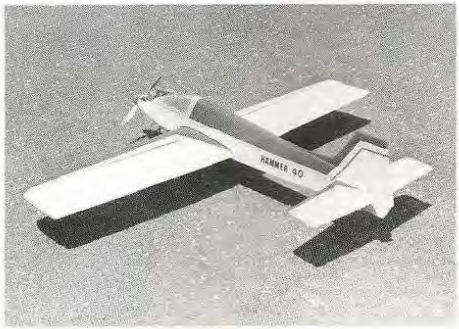
This view of the framed-up aircraft shows the plug-in fittings (**above**): the 3/4" 6061-T6 aluminum tube spar, the fiberglass spar receptacle tubes in the wing, and the 1/8" wire kep pin which positions the wing. Using the plug-in arrangement (**below**), installation of the pipe is easy. For rear exhaust engines, there's plenty of room in the upper fuselage to enclose a pipe in the upper forward section which can be made removable.





For the extra effort, the plug-in version gives you plenty of room in the fuselage for the radio equipment. Ailerons are actuated by the top left servo in the photo. The linkage uses a square drive to actuate each control surface because of the plug-in feature. Access to the radio via a simple hatch on the bottom.

Four *Hammer .40* prototypes, built by some of Dick's modelin' buddies, proved that the new design works just fine. Ted Morlock (**above left**) built a low wing version as did Lance Schneider (**above right**). To prove the *Hammer .40's* construction options, Bob Bennett (posing with Dick) built this taildragger version (**below left**). That's Bob Peru's plane (**below right**) which will serve as the prototype for Champion Model Aeroplane's low-wing kit version.



the plywood doublers to the balsa side pieces; be sure to make a right and a left side. I use epoxy for attaching the doublers. Also add the wing saddle doublers, the hardwood wing mounting blocks, and the triangle stock where needed. The two sides are now joined with the firewall and the next two bulkheads; the sides are parallel from the firewall to the wing trailing edge location. The sides are pulled together at the tail and the two rear bulkheads glued in place. The upper side pieces are beveled on their edges to fit and then glued in place, followed by the top blocks. Install the pushrods for rudder and elevator control before adding the fuselage bottom planking. I then install the engine mount and the engine, plugging the engine to protect it from sawdust, then add the cowl blocks, fitting them so they can be shaped to fair into the spinner.

If the plug-in wing/enclosed pipe version is built, the forward top fuselage section is made removable for access to the pipe. The hatch can be held in place with several small screws into hardwood blocks. A floor installed below the pipe area will isolate it from the fuel tank and radio gear compartments.

When the wing is fitted to the fuselage and aligned with the retaining dowels and nylon mounting bolts, the small lower section of the fuselage is glued in place to the bottom of the wing. If using a tuned pipe, reinforce the pipe mounting bracket area with plywood set into the fuselage where needed.

Lance Schneider's plane holds a rock steady approach as the *Hammer* heads for the runway. Whether low wing or mid-wing, the new *Hammer .40* exhibits the same excellent flight characteristics.

Tail Surfaces. The tail surfaces are simply cut and shaped from 1/4 inch balsa sheet. Check alignment carefully as you fit the wing to the fuselage and glue the tail surfaces in place. All surfaces and the engine are mounted at zero degrees incidence. I use DuBro nylon hinges and like the DuBro Kwik-Hinge Slotter tools for hinge installation.

Finishing

Because of the added weight of the plug-in wing feature, I covered the wing panels and horizontal stab with an iron-on plastic film rather than my usual Silkspun Coverite and dope finish. The fuselage and fin/rudder were painted with Sig butyrate dope. A Kraft molded engine mount was used and a Sullivan fuel tank. The nose gear steering block was bolted to the rear of the firewall. My Mac's Products tuned pipe ran beneath the plug-in wing and a mounting bracket with a small hose clamp held it in place. The engine was mounted at about a 45 degree angle to position the pipe correctly and it did not interfere with installation or removal of the wing panel. A removable plywood hatch on the bottom of the fuselage provided access to the radio gear area. My plug-in aircraft version weighed 5½ pounds ready to go. I'm sure the more conventional version would be lighter.

I learned a lot from this first experience with plug-in wings. The aluminum tube spar, fiberglass tubes for the wing panels, and the plug-in aileron linkage all worked fine. I believe the real benefits of plug-in wings would be worthwhile in larger models, not in this .40 sized aircraft. But the mid-wing appearance sure looks good to me!

Reviewing this article and thinking again about the plug-in wings after a discussion with Bob Hunt and his original plug-in wing pattern aircraft, another thought is worth mention. Different wing panels could be built to plug in for experimentation and actual performance comparison. Higher versus lower aspect ratio, different planform tapers, different airfoils, larger or smaller wing areas, tip ailerons versus strip ailerons, thicker or thinner wings, more or less dihedral - all could be tried on the same fuselage to really see which performs best. It might even be desirable to use larger wing panels in calm weather or for turnaround pattern use, and smaller wing panels for windy weather conditions. Maybe a set of thinner wings when you want to go faster. How about undercambered panels for some thermal soaring? Only kidding, I lost my head. The possibilities are there.

Late News

Champion Model Aeroplane Co., one of FM's advertisers, plans to produce a kit for a low wing version of the *Hammer 40*. Write to them for information.

Destined to be a "classic", Dick's prototype rests on the hood of another, bona-fide classic, a 1964 Chevelle Malibu Super Sport. Both are the work of versatile author Sarpolus with help from his son, Rick.